

SEQ

SEQUENTIAL FLASHING WARNING LIGHTS FOR WORK ZONES



Sequential Flashing Warning Lights for Work Zones

**Kristie Drury, P.E.
Oklahoma Turnpike Authority**

**OTEA Fall Meeting
Edmond, Ok**

October 18, 2012

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Sequential Barricade Warning
Light System

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What is TIG?

TIG:

- AASHTO Technology Implementation Group

TIG:

- Dedicated to sharing...
 - high-payoff
 - market-ready technologies

TIG:

- Accelerating adoption of innovation among...
 - peers in U.S. transportation agencies

For more information visit tig.transportation.org.

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What is a Sequential Flashing Warning Lights for Work Zones?

Due to highway congestion, nighttime work is becoming an increasing practice.

- Enhance nighttime work zone visibility of merging tapers, especially on Interstates.
- Increase driver awareness of an approaching work zone.
- Reduce speed toward speed limit compliance.
- Enhanced Safety at merge tapers at night for drivers and workers.
- Maximize traffic flow: promotes smooth lane merge to reduce back-ups.

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MUTCD and SEQ:

- **MUTCD 2009 provided sequential warning lights as an option.**
- **Option:**
“A series of sequential flashing warning lights may be placed on channelizing devices that form a merging taper in order to increase driver detection and recognition of the merging taper.”
 - **Standard:**
“If a series of sequential flashing warning lights is used, the successive flashing of the lights shall occur from the upstream end of the merging taper to the downstream end of the merging taper in order to identify the desired vehicle path. Each flashing warning light in the sequence shall be flashed at a rate of not less than 55 or more than 75 times per minute.”

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Sequential Flashing Warning Lights for Work Zones

- Oklahoma DOT's use in 2010
- Missouri DOT's use in 2010-2011
- University of Missouri-Columbia Study
- Future Use of Sequential Warning Lights

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Oklahoma DOT



Missouri DOT

- Sequential warning lights used on I-44 Maintenance nighttime project.
- 20 sequential lights used on shoulder and merging taper.
- From the review of work zone, MoDOT brought set of 20 for each of their districts.
- Investigated in a university study of the lights.

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UK Video



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Cost-Benefit Analysis of Sequential Warning Lights in Nighttime Work Zone Tapers

By

Carlos Sun, Ph.D., P.E.

Praveen Edara, Ph.D.

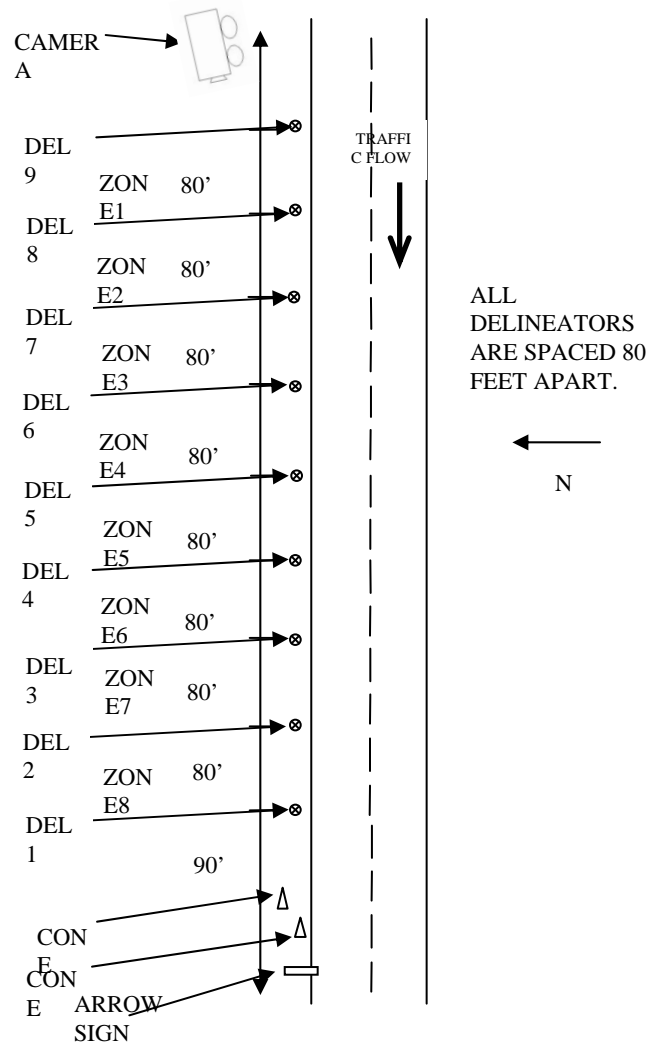
Yi Hou

Andrew Robertson

Summary of Cost Benefit Analysis

- Studied one urban and two rural interstate projects.
- Rural speed limit decrease from 70 to 60 mph.
- Urban speed limit stayed 60 mph.
- Video and Radar data was collected.
- Data collection for each site was 3 hours with a 90-minute split with and without lights.
- Data was collected from the taper to 730-feet upstream of the taper.
- The data collection area was split into 8 different zones as shown on next slide.

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Findings were placed in five categories.

- Total Vehicles
- Passenger Cars
- Trucks
- Rural Work Zone
- Urban Work Zone

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85th Percentile Speed & Mean Speed				
	With Lights 85 th (mph)	Without Lights 85 th (mph)	With Lights Mean (mph)	Without Lights Mean (mph)
Total Vehicles	62	63	55.55	57.76
Passenger Cars	63	64	56.50	58.7
Trucks	60	61	53.80	56.30
Rural Work Zones	63	63	57.65	58.43
Urban Work Zones	60	62	53.09	56.24

The traveling public did reduce their speed with the sequential lighting system within the studied area.

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Speed Limit Compliance Rate

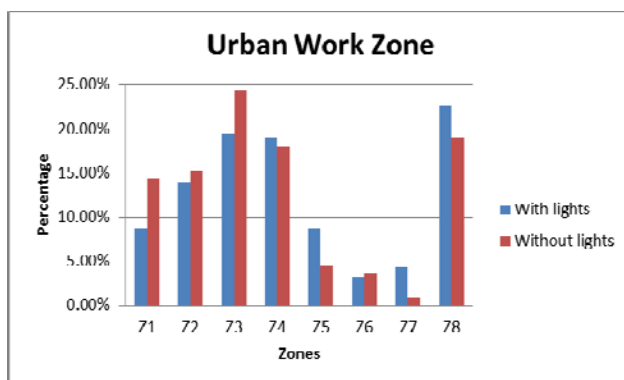
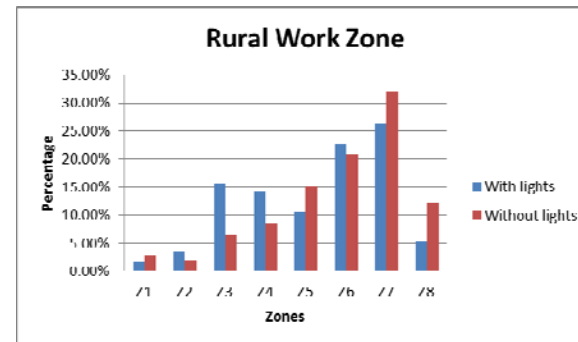
	With Lights (%)	Without Lights (%)
Total Vehicles	78.1	71.4
Passenger Cars	73.1	65.2
Trucks	87.3	80.9
Rural Work Zones	69.0	68.3
Urban Work Zones	88.8	78.4

There was an increase of compliance with the work zone speed limit within the studied area.

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Rural work zones shows the traveling public merging earlier in the zone 1-5 with the lights. There was a 10 percent increase of merging in those zones with the sequential lighting.

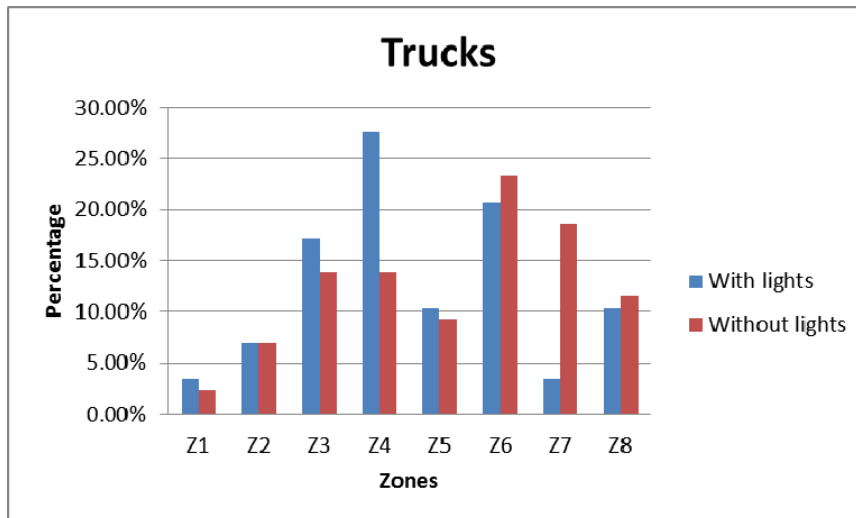
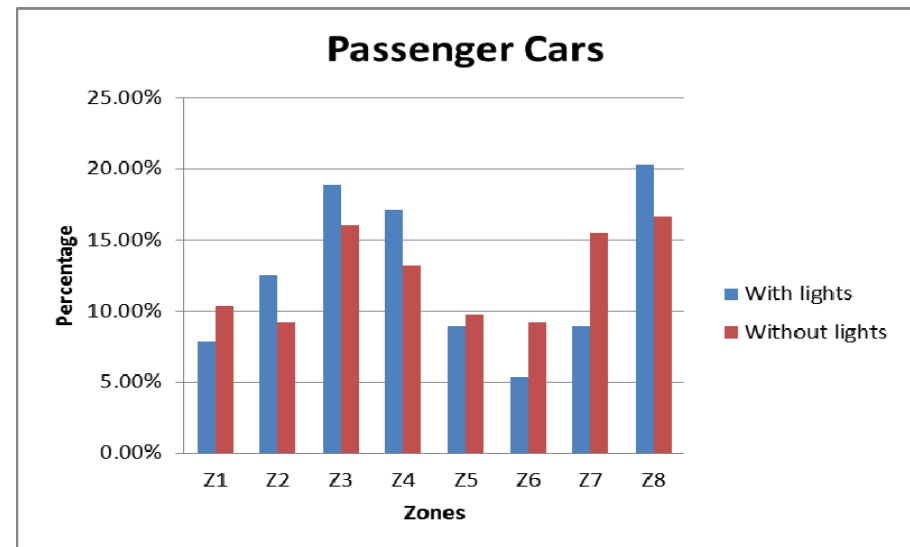


The urban work zone showed early merging for non-lighted scenario, but show a larger amount of late merging (zone 8) for lighted scenario. In the urban work zone, there were more vehicles, about twice, in the *lighting* scenario than *without lighting* scenario. With more vehicles, there were fewer gaps in the open lane that led to some drivers delaying their merge closer to the taper area (Zone 8).

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For passenger cars, the first 5 zones showed a 6.74 percent increase of vehicles merging earlier. Again, there was an increase of 4 percent in zone 8.

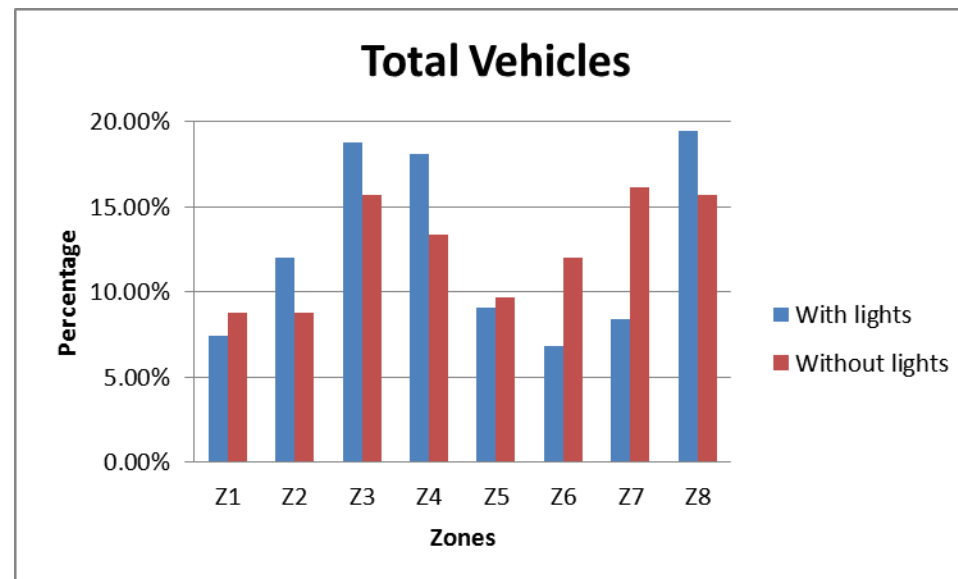


Trucks showed a 19 percent increase of merging in the first 5 zones, when sequential lighting were deployed

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Overall performance showed an increase of 10 percent of vehicles merging in zone 1-5 with the sequential lighting system. There was an four percent increase of merging in the late zone #8.





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Report Summary

- In summary, sequential lights appear to be an effective tool for improving driver awareness of the work zone taper.
- Appear most effective with trucks and rural work zones as compared to passenger cars and urban work zones.
- Most measures of performance support this conclusion since speeds were reduced and merge distances increased.
- A small percentage of aggressive drivers caused an increase in speed variability and late merges.
- No operational or synchronization problems were observed in the lab or in the field.

Future Use of Sequential Warning Lights

- MoDOT has been using sequential lighting on Maintenance nighttime interstate projects.
- MoDOT is developing guidelines for use of sequential lighting on nighttime interstate projects.
- ODOT is using sequential lighting on nighttime projects.
- OTA will be using sequential lighting on all nighttime projects on the Turner Turnpike.

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Questions?



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